



TWO – STAGE COLLABORATIVE GROUP TESTING IN GENERAL PHYSICS CLASS

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ABSTRACT

Two-stage collaborative group testing has been widely used as a mean of formative assessment in other foreign countries; however, there are no known researches so far of its use in the Philippines. This study aimed to determine if there is an improvement in the test scores of the respondents utilizing the two-stage collaborative group testing. A triangulation approach was used in the study with one hundred eleven (111) sophomore students from the college of teacher education. T-test for two independent sample were used to determine the effectiveness of two stage collaborative group testing, in addition to this, questionnaires were given pertaining to its perceived benefits. The respondents were asked to write their experiences on the use of the strategy, the written answers were grouped into categories and coded. Results revealed that there was a significant increase in the test scores of the students after having collaborative group testing in the four quizzes (problem solving) and two major examinations (multiple choice) in General Physics. Most of the respondents have agreed that two-stage collaborative group testing benefitted them in terms of working together (4.50), negotiating differences (4.48), and improved positive relationships (4.40). Sharing ideas and working together (34.23%) and reflection on the answers (30.63%) were the concepts that mostly emerged from the respondents when asked them to write their experience on the use of two stage collaborative group testing. It was concluded that the use of the strategy can be an effective form of formative assessment especially when the result of traditional test given to learners have a lot of corrections to make.

KEYWORDS: Two-Stage, Collaborative Group Testing, Formative Assessment, General Physics.

INTRODUCTION:

One of the keys emerged in the reviewed done by Black & Dylan (2012) regarding assessment is that formative assessment should promote feedback between students and teacher. The problems in traditional exams is that teacher give the test individually through paper and pencil test wherein students rarely know the feedback of the result of the test (Spiller, 2009; Gibbs & Simpson, 2005). More often than not, teachers did not discuss the answer to the questions given in the test. However, the situation has disadvantage on the students' part as their unbecoming concept in some of the questions given to them will not be corrected. It also reduced students' motivation and affects their self-esteem whether the students are low or high performing (Black, et.al. 2012). A scenario that needs careful attention subsequently, what the educators are aiming is to produce well-rounded students.

Brown (2005), concluded that teachers should explore how the assessment practices would help the learners rather than hinder learning. Ochoa, et.al. (2003), enumerated various problems associated with evaluation of knowledge and these are the following; (1) ambiguity, (2) anxiety and; (c) lack of uniformity in grading system. These problems were remediated through a self-evaluation scheme, co-evaluation or evaluation of peer, and multiple choices. But all of the remediation done was not able to reduce or neutralize the problem. It also did not promote learning during the process of evaluation. In this framework, new form of methodologies is required to make a significant change in the traditional classroom assessment practices. It was concluded that summative tests should be integrated in the learning process in which students can be involved in the test process (Black, et.al. 2012). This would be a big benefit on the part of the students in terms of clarification of concepts.

In the constructivist theory of learning, prior knowledge is considered as important aspect in determining students' capacity to learn new things. That is why collaborative learning is one of the activities included in the K to 12 and undergraduate curricula in the country. Collaborative learning is also the anchor in socio-cultural theory wherein learning occurs in the interaction between individual and social environment (Vygotsky 1978). Learning is social in nature wherein the knowledge of an individual can be developed through group sharing. Research in science education has studied on the benefits of collaborative learning as one of the pedagogies used in the teaching and learning environment. Studies reveal that collaborative strategy improves students' performance (Akinbobola, A.O., 2009; Ebner, M. et.al. 2014; Sharma & Singh, 2016).

Cotright, et.al. (2002) emphasized the significance of test in instruction wherein he viewed that test should not be merely a basis for giving grades but also as mechanism for evaluating students' performance and teaching process as well. However, the existing activities done in collaborative learning emphasized the discovery of learning based on the first part of the discussion, motivation and activity, and not on the evaluation part. In other countries, collaborative group testing in written examination have been used in some universities in United States since 2009, wherein students undergo two stages of the same set of examination. In the first stage, they would take the test individually and then immediately after, they take the second test in groups (Wieman C 2014.). The team test provides an imme-

diate opportunity for students to discuss, debate, teach, and receive feedback on the subject matter. It draws on principles of goal-directed practice, timely targeted feedback, and collaborative learning.

The lack of significant assessment practices brought educators to propose a new strategy that focuses on making group work as part of the examination process. Several studies came out regarding collaborative testing (Ochoa & e al, 2003; Wieman, 2014; Cotright, et.al. 2003; Giuliodori, 2008; Meseke, 2010; Rieger, 2014; Gilley & Clarkstond, 2014). They sometimes call it as two-stage exams, but conceptualizing it, two-stage exam is one way to implement the collaborative group testing. The strategy involves students deeply engaging in learning through the feedback from the group which will be received immediately during the summative test. As far as the researchers' understanding, there is no research yet done in the Philippines on collaborative testing using two-stage exam. Ochoa S. et.al. (2003) in Universidad de Chile initially termed it as Examining Together Technique (EET) and Collaborative Evaluation technique (CET). Research in Physics Education shows collaborative group testing is a strategy for good formative assessment (National Academy, 2000, as cited in Wieman C., 2014).

The two-stage collaborative group testing approach is defined as a form of formative assessment where students work together in an environment of small groups during summative tests (Meseke C. A., 2010). It offers a new breadth of assessment since students learn in the process (Wieman C., 2014). This approach was a feature of team-based learning wherein (Fengler M. & Ostafichuk P., 2015) small groups usually composed of 3 to 4 students emphasize preparation out of class and apply the knowledge in class. It serves as a form of formative assessment needed in order to assess prior knowledge of the learners (Harlen, 2007).

In 2004 Jenkins proposed collaborative testing he termed as group-based assessment class which is tapped as one of good forms in computer-aided formative assessment. It focuses on group discussion for assignment preparation through weblogs. It was used as a group tool that can allow an individual to post reflective messages and then peers can give feedback and ask questions. In this view, the key concept for e-learning classes is to engage students in sharing of ideas and experiences which require a continuous feedback and process that may come from peers and instructor. On the other hand, two-stage examinations can also serve the same purpose – to share ideas, feedback and experiences.

Moreover, two-stage examinations were found to increase the learners' engagement through in-class collaborative activities and students have felt more the value of peer discussion (Rieger & Heiner 2014). On the other hand, Meseke (2010) found out that students gain increased performance in Science and better testing attitude after being subjected to collaborative testing. It was concluded that students having an individual test obtain an equal learning with those of students having collaborative test.

Gilley & Clarkston (2014) compared the performance of groups of students exposed to individual and collaborative testing. Though the individual students increased in their scores during the retest, it was the collaborative group retest that has the greater increase in the scores. The same finding was obtained by Rao,

S.P. et.al. (2002), in all types of tests, whether multiple-choice, short essay, true/false, or fill in the blanks. Students were found to have significantly increased the results of their tests when they completed the exams with initially incorrect answers were able to correct their answers after having discussion with peers (Giuliodori, M.J. et.al., 2009). In the undergraduate program of the teacher education at Laguna State Polytechnic University, college in groups than when

taken individually. Collaborative testing also shows positive effects since most students seem uninterested in physics as their specialization. This is reflected in the few students that took physics as their specialization as compared with other major subjects offered by the University since teacher education program was started (see Table 1).

Table 1
Total number of graduate Education students per program from 2001 to 2017.

Program	Number of graduates per year																
	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17
English	34	41	43	58	37	44	36	31	34	26	22	39	59	35	53	27	50
Filipino	26	24	24	39	18	31	20	4	8	8	9	6	12	19	26	15	47
Physical Science	8	21	16	30	19	21	20	11	6	3	1	2	7	9	11	11	13
Social Science	15	25	25	48	35	40	42	17	13	15	14	28	24	28	42	24	51

Source: Job Placement office LSPU-SCC

This trend may be due to the fact that students find difficulty in understanding physics subject (Geronimo, V. 2016). Several researches reveal that students have negative attitude towards Physics (Kaya, H., & Boyuk, U., 2011; Alao, E. A., 1990; Solbes, J., Vilches, A., Reid, N., & Skryabina, E. A., 2002.), the reason why Physics educators have exerted their effort in researching on pedagogies to help teachers teach physics and other science subjects as well (Wieman, C. & Gilbert S. 2014).

Two-stage collaborative group testing is a methodology that offers a new breath of opportunity to educators who want new ways of enhancing the learners' concept in science. The researchers became interested in employing the two-stage collaborative group testing as one innovative approach in teaching general Physics classes in the College of Teacher Education at the Laguna State Polytechnic University during the first semester of academic year 2016-2017. The general aim of this study was to determine the students' performance when subjected to collaborative group testing through two-stage exams and their evaluation on the strategy. In addition, respondents were asked to describe their experiences during collaborative group testing.

MATERIALS AND METHODS:

This study utilized mixed method research design in a form of triangulation. Quantitatively, two-stage collaborative group testing study was used to sophomore undergraduate students taking up general physics subject. A total of 111 (n) undergraduate students from the College of Teacher Education in the University were the respondents of the study. The 111 students were composed of four sections with different majors namely Physical Science (13), English (35), Social Science (38), and Filipino (25). They were chosen using purposive sampling technique.

Stage 1 of the implementation part was when learners took the test within 3/4 of the examination time; a standard formal examination that students completed working alone. While on Stage 2, after students turned in their individual exams, small groups solved or answered similar or identical problems during the remainder of the examination time. On this phase, the groups were free to talk and debate with other members of the group and decide on what were the most probable answers.

The collaborative group testing was done every time the teacher gave a test whether it was in the form of a quiz, long test or term examinations. For this study, two-stage collaborative group testing was employed into five (5) quizzes, which is in the form of problem solving type of test and two major examinations in multiple choice type of test. It was done during the first semester of academic year 2016-2017. Topics included were measurement, forces and motion such as vectors, freefalling bodies, newton's laws of motion,

To determine if there was an improvement in the respondents' performance in Physics during collaborative group testing, the scores gotten in individual testing were compared with the scores in group testing with the same set of problem. It was analyzed using T-test for two independent samples.

A questionnaire was administered to them about their perception on the benefits of two-stage examination testing using a five-point likert scale with a verbal interpretation of 5 as strongly agree, 4 as agree, 3 as moderately agree, 2 as disagree, and 1 as strongly disagree.

To further describe respondents' experiences during the two-stage collaborative testing, qualitative analysis was utilized. They were asked to write their experiences on the use of two-stage collaborative group testing in one or two sentences; their answers were grouped into common characteristics, were coded and interpreted.

RESULTS AND DISCUSSION:

Respondents' Performance in Individual and in Two Stage Collaborative Group Testing:

Table 2 illustrates the means, standard deviations for individual and collaborative group testing. Paired sample t-test was utilized to determine whether the scores between individual and group testing differ significantly. The present study depicted that there is a significant difference in the scores ($p < .001$) between the individual and collaborative group testing in terms of quizzes number two to five wherein problem-solving type of test was administered.

While no significant difference in number one quiz ($p < .173$), most probably, this is due to the initial reaction of the students in the instructions and the strategy is somehow new to them. As first timers, the members of the group were trying to adjust with each other. As for the multiple-choice type of test (middle term and final term examinations), it was revealed that there was a significant difference between individual and group scores ($p < .001$). This indicates that the students even a multiple-choice type of test utilizing two-stage collaborative was also effective.

Table 2
Significant difference on the mean scores for several examinations

	Individual (111)		Group (111)		Difference	t	df	P
	M	SD	M	SD				
Q1	11.30	3.72	11.80	3.66	-0.50	-1.37	107	.173
Q2	17.36	4.71	19.55	4.70	-2.19	-4.30	105	<.001
Q3	16.99	6.51	21.44	6.57	-4.45	-6.46	108	<.001
Q4	13.70	3.70	15.15	3.79	-1.45	-3.65	106	<.001
Q5	11.60	4.68	14.90	3.81	-3.30	-6.78	100	<.001
MT	31.21	6.84	37.80	8.34	-6.59	-6.94	110	<.001
FT	25.78	5.38	29.96	5.19	-4.18	-7.67	110	<.001

Note: Values of the degrees of freedom differ for the five quizzes indicated that some respondents were absent during the day of the evaluation.

The results, in general, indicate that there is an improvement in the performance of the students in their tests scores; this is in accordance with the findings of the studies of Meseke (2010) and Gilley & Clarkston (2014) that students have improved performance in Science after being subjected to two stage collaborative group testing. Though there was no significant difference in the first trial of the strategy, the difference in the next successive tests was observable. This study verified that two-stage collaborative group testing strategy is effective in the general physics class using problem solving and multiple type of test which is in congruent with the results of studies of Ochoa & e al. 2003; Wieman, 2014; Cotright, et.al. 2003; Giuliodori, 2008; Meseke, 2010; Rieger, 2014; Gilley & Clarkstond, 2014.

Benefits of Two Stage Collaborative testing:

Respondents were asked to answer the questionnaire regarding their self-perceived benefits on two-stage collaborative testing wherein indicative statements were shown in table 3. It appears in the data that respondents have very high perception regarding the benefits of two-stage collaborative groups testing in term of working together (4.50), negotiating differences (4.48), improving positive relationships (4.40), providing opportunities to evaluate personal understanding (4.37), and enhancing understanding of the concepts (4.37). It also had the highest mean on the benefits of collaborative group testing on the self, namely, interest (4.24), increase in the level of confidence (4.23), and self-reflection (4.26)

Table 3
Perceived Benefits of Two-Stage Collaborative Testing

Indicative statement	M	
1. I became more interested in Physics when I engaged in two-stage collaborative testing process.	4.24	Very high
2. My level of confidence improved when I engaged in the two-stage collaborative testing	4.23	Very high
3. I feel less stressful with the collaborative testing than the traditional one.	4.09	high
4. The collaborative testing provided opportunities for me to evaluate my personal understanding in physics	4.37	Very high
5. The level of group discussions enhanced my understanding of the concepts	4.37	Very high
6. Two-stage Collaborative testing reduced my anxiety during examination in physics.	4.18	high
7. I learned to reflect on my own answers during collaborative process.	4.26	Very high
8. Two-stage Collaborative testing increased my ability to negotiate differences.	4.48	Very high
9. I was able to recall concepts because I had the opportunity to previously discuss them within the group.	4.07	high
10. I can freely discuss/speak up in class activities during the second stage of the exam	4.02	high
11. I tend to value peer discussions more.	4.11	high
12. I am prepared to carry out peer discussions in a two-stage exam than during the lecture.	3.92	high
13. We discussed the questions until all members agree on the answers.	4.51	Very high
14. We worked together to discuss concept/terms in physics rather than relying on one student.	4.50	Very high
15. The immediate feedback given in the group discussions encouraged me to get more involved in the group discussions	4.29	Very high
16. The collaborative testing process was too lengthy that It became boring during group discussion.	2.79	Moderately high
17. Two-stage Collaborative testing improved positive relationships with my Peers	4.40	Very high
18. Two-stage Collaborative testing provided the opportunity to discuss incorrect answers and fill in the knowledge gap.	4.34	Very high
19. Every member of the group contributed to the learning process during collaborative group testing.	4.20	high
20. The level of group discussion was very high.	4.07	high
wm	4.17	high

The mentioned indicative statements were observed to have the highest mean compared with other statements. This implies that the strategy has a positive effect on them since they can freely talk during the course of the two-stage collaborative testing. On the fact that strategy provides to work together the group tends to rely with what they agreed upon as a group and obviously, no one relies in only one student.

One noticeable statement is that learners were more prepared to carry out peer discussions in a two-stage exam than during the lecture which got the second lowest mean (3.92) because their grades relied on how they did the peer discussion, unlike during lecture hours. Some students tend not to cooperate because they think that it has no big impact on their grade.

On the other hand, on the statement "The collaborative testing process was too lengthy that it became boring during group discussion" had a remark of high which obtained the lowest mean of 2.92. This mean that students tend to disagree with the statement that, for them, the two-stage collaborative testing was fun and entertaining.

When the respondents were asked to write their experiences on two-stage collaborative testing, the responses were grouped into five categories (a) sharing or working together, (b) eliciting different ideas, (c) self-reflection or understanding own mistakes, (d) unity or teamwork, and (e) ease/convenience/helpfulness. The highest mean was verified with the survey that working together, negotiating differences, improving positive relationships also reflected as highest frequency in their write up.

Table 4
Respondents' write-up on the two-stage collaborative testing

Theme	Frequency	Percentage	Rank
a. Ease/convenience	7	6.31%	5 th
b. Eliciting different ideas	17	15.31%	3 rd
c. Self-Reflection of Answers	34	30.63%	2 nd
a. Sharing/working together	38	34.23%	1 st
d. Unity	15	13.51%	4 th
Total:	111	100%	

with 38 (34.23%) of the respondents who agreed that sharing ideas in answering the questions given by the teacher was dominantly observed on collaborative group testing. Since they were having discussion with the aim for the right answer, the learners were serious in giving their explanations or knowledge about the problems given. Below were some of the respondents' views on two-stage collaborative group testing:

Respondent 1: "Each member shares their ideas about the exam and gets the

correct answer because we work together."

Respondent 2: "It is productive and comfortable because there are questions in which I don't know the answer but my group mates explain it to me. They will share their answers and also mine. We compare it and then solve it again to check if we have the same answer."

Respondent 3: "Happy and amaze because we share our knowledge to each other. Amaze because we don't know what to do but the other group know almost a lot of things."

The second in rank that mostly the learners agreed upon was that 33 (30.63%) of the total respondents were able to reflect their own answers, one of the most important aspects in the learning process. The responses given by the respondents marked by the words 'realized' and 'enlightenment' showed how they reflected their own answers which remarked as high in the survey with a statement of providing opportunities to evaluate personal understanding (4.37). The study indicates that the strategy promotes learning through reflection which was concluded in the study of Ochoa & et al. (2003)

Respondent 1: "I realized that in some questions we have different answer. We exchange knowledge that we know about certain question"

Respondent 2: "Peer teaching is applied and we know or realized our wrong answers through group exams"

Respondent 3: "I can describe that experience as the moment of enlightenment".

It was noted that 17 (15.31%) of the respondents agreed that two-stage collaborative testing greatly help as a tool to obtain lots of ideas coming from their group mates. Ideas flow freely within the group whether it is the right concept or not which is also tallied with the result of the survey that two stage collaborative group testing can enhance understanding of the concepts (4.37). As some of the respondents said:

Respondent 1: "We are able to get the idea of each other, so it is easy to answer the question and we also have brain storming."

Respondent 2: "It is very nice because of the many ideas that we have the more correct answers that we get."

Respondent 3: "It gives me new idea, because when I was asking my classmates they are answering me even if it was hard for them but they are doing their best just to share their knowledge to me."

On the other hand, unity which had a frequency of 15 (13.51%) was 4th in rank. This means that having discussion during the retest makes the group more uni-

fied and it strengthens their decision-making skills on answering the written questions. The concept of unity came out in their write wherein this idea is not indicated in the survey. The respondents wrote:

Respondent 1: *"It made me and my classmate unite because we are discussing our different answer and opinion. Each one of us was asked about our opinions and to come up with the answer. If the answer is too different, a voting system is used."*

Respondent 2: *"It is fun and easy because there is more than one person working out to solve the problem. Teamwork is also practiced."*

Respondent 3: *"I find it enjoyable because we can share our opinions to each other and it really allows interaction between me and my co-members. I realized that COOPERATION is a MUST."*

However, 7 (6.31%) of the respondents said that it was more convenient or easier to use, this had the lowest number of responses compared with other categories about collaborative testing indicating that the said strategy is not that easy to use. This can probably be due to how it requires enough time and effort for the group to discuss and adjust with their differences.

Respondent 1: *"It's easier to answer and solve the problem because of different ideas that others are sharing on how to do the problem"*

Respondent 2: *"We shared knowledge about the exam and learned as well our mistakes in the individual exam. It makes the tasks easier to do."*

Respondent 3: *"The exam is much easier to answer if we were answering it by group because We can compare our answers to our group mates."*

Before writing the answer on the retest, there was group discussion on what might be the exact and correct answer on the questions given in the test. The free access of the members to reach and to talk to their classmates was a very good indication of healthy learning environment. As reflected on their answers, the best way to get ideas from other classmates is through discussions conducted during the two-stage examination. Furthermore, the members of the group were more intent on listening to each other during this strategy than with the ordinary conversation they had. As an overall perception of the researchers, students reacted positively to the group testing as in alignment with the conclusion of Fengler & Ostafichuk (2015). Generally, collaborative testing in general physics was beneficial to the second-year college students

CONCLUSION:

Two-stage collaborative testing is a new methodology for the education students that was proven to increase their scores in physics in the form of problem solving and multiple-choice type of tests. Utilizing it also gains a positive perception on them. This is another confirmation of several studies that collaborative group testing can be an effective tool of formative assessment wherein corrected answers in summative tests can be elaborated through the interaction with group, thus, learning experiences can expand through its implementation. However, the strategy as experienced by the teacher consumed more time in the actual setting. As for the teacher, the projected time to finish the content in the syllabus might not be reached if the strategy will be used in all the quizzes and major examinations. This implies that teacher has to analyze carefully the learner's misconception on the subject based on the results of the individual exams before administering the second stage. It is also suggested to use the two-stage in other type of tests aside from the type of tests administered in the study. In addition, to further analyze its effectiveness, it is recommended to compare the results of individual retest with that of group retest.

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